PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P18737WO1	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/SE2003/002039	International filing date *(day/month/year)* 19-12-2003	Priority date *(day/month/year)* –
International Patent Classification (IPC) or national classification and IPC See Supplemental Box		
Applicant Telefonaktiebolaget LM Ericsson (PUBL) et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of __7__ sheets, including this cover sheet.

3. This report is also accompanied by ANNEXES, comprising:

   a. ☒ *(sent to the applicant and to the International Bureau)* a total of __5__ sheets, as follows:

      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).

      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.

   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s))
   _____ , containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

   ☒ Box No. I   Basis of the report

   ☐ Box No. II   Priority

   ☐ Box No. III   Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

   ☐ Box No. IV   Lack of unity of invention

   ☒ Box No. V   Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

   ☐ Box No. VI   Certain documents cited

   ☐ Box No. VII   Certain defects in the international application

   ☐ Box No. VIII   Certain observations on the international application

Date of submission of the demand 01-06-2005	Date of completion of this report 29-03-2006
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. +46 8 667 72 88	Authorized officer Markus Stålö / MRo Telephone No. +46 8 782 25 00

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Cover sheet

International patent classification (IPC)
H04L 25/02 (2006.01)

Box No. I	Basis of the report

1. With regard to the **language**, this report is based on:

    ☒ the international application in the language in which it was filed

    ☐ a translation of the international application into _____ ,
    which is the language of a translation furnished for the purposes of:

      ☐ international search (Rules 12.3(a) and 23.1(b))

      ☐ publication of the international application (Rule 12.4(a))

      ☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

    ☐ the international application as originally filed/furnished

    ☒ the description:

      pages 1-11 _____ as originally filed/furnished

      pages* _____ received by this Authority on _____

      pages* _____ received by this Authority on _____

    ☒ the claims:

      pages _____ as originally filed/furnished

      pages* _____ as amended (together with any statement) under Article 19

      pages* 1-5 _____ received by this Authority on 14-02-2006 _____

      pages* _____ received by this Authority on _____

    ☒ the drawings:

      pages 1-3 _____ as originally filed/furnished

      pages* _____ received by this Authority on _____

      pages* _____ received by this Authority on _____

    ☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

      ☐ the description, pages _____

      ☐ the claims, Nos. _____

      ☐ the drawings, sheets/figs _____

      ☐ the sequence listing *(specify)*: _____

      ☐ any table(s) related to the sequence listing *(specify)*: _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

      ☐ the description, pages _____

      ☐ the claims, Nos. _____

      ☐ the drawings, sheets/figs _____

      ☐ the sequence listing *(specify)*: _____

      ☐ any table(s) related to the sequence listing *(specify)*: _____

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

Form PCT/IPEA/409 (Box No. I) (April 2005)

Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	6-14,16-20,22-25	YES
	Claims	1-5, 15 and 21	NO
Inventive step (IS)	Claims		YES
	Claims	1-25	NO
Industrial applicability (IA)	Claims	1-25	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

The claimed invention
The invention concerns a method, signal format and device for estimating multipath channel parameters and composing channel measurement messages based on the estimated channel parameters. The invention solves the problem with too large an amount of data being transmitted between receiver and transmitter, wherein the information transmitted is a representation of the channel function. The channel function representation is used for advanced adaptation of the coding, bit rate and modulation format in the transmitter. The aim is to provide detailed channel information to the transmitter with a minimized amount of transmission capacity.

The problems are solved by a receiver estimating and transmitting parameters of the channel filter function to the transmitter.

Prior-art
Reference is made to the following documents:
D1: "Theoretical bounds on the estimation and prediction of multipath time-varying channels", by Barbarossa S. et al.
D2: "Space-time transmit strategies and channel feedback generation for wireless fading channels", by Visotsky E. et al
D3: "Adaptive transmitting antenna arrays with feedback", by Gerlach D. et al.
D4: "A multipath channel model for mobile-radio communications", by Papantoniou S.J.

.../...

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: Box V

Document D1 describes a simple and effective method for estimating channel parameters such as path delays, amplitudes, phases and frequencies. Since the channel impulse response varies rapidly and its physical parameters, such as reflection coefficients, delays and Doppler shifts vary much slower, channel parameters rather than the impulse response samples are estimated and transmitted back to the transmitter. The transmitter uses the channel parameters for channel prediction and to optimize the coding strategy (see for example page 2545-2546 Chapter 1 Introduction and Chapter 2 Channel Model).

Documents D2-D4 represent the general state of the art.

Statement of reason
In response to the written opinion, the applicant states that document D1 does not present a method that provides a message format with detailed channel information while requiring minimised transmission capacity.

Document D1 states that a receiver estimates the channel and sends channel status information back to the transmitter and that it is desirable to avoid frequent channel estimates (see D1 page 2545 left-column approx. lines 30-40). Therefore, a solution is presented wherein the receiver computes a parametric model and rather than transmitting the impulse response samples it is more efficient to compute and transmit reflection coefficients, delays and Doppler shifts (see D1 page 2545 right-column lines 10-18).

All transmissions between a transmitter-receiver pair must include a defined message format. D1 does not mention such a message format, but it is evident that document D1 contains such a message format, wherein the computed parameters such as reflection coefficients, delays and Doppler shifts are transmitted. Further, the independent claims in your application do not specify the message format more than that it includes "a part for parameter representation and a part indicating the manner of representing said parameters", i.e. any message format.

.../...

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of: Box V

The applicant further argues that "Further, with guidance of claims 1 and 21, D1 is completely silent and does not provide any disclosure of a representation of (1) complex parameters of at least a selection of parts of the channel filter function, (2) the possibility to represent the information as actual or incremental values, (3) a channel measurement message including a part for parameter representation and a part indicating the manner of representing said parameters".

1. Document D1 describes, as mentioned above, that reflection coefficients, delays and Doppler shifts are computed from a multi-path channel model (see D1 equation 1, and page 2545 last lines on right-column).
2. Document D1 computes and updates regularly the channel estimates, i.e. the reflection coefficients, delays and Doppler shifts parameters. The time between successive updates of the parameters is studied in D1 Chapter 3.
3. Document D1 does not mention a message format (as stated above), but the independent claims in your application do not specify the message format more than that it includes "a part for parameter representation and a part indicating the manner of representing said parameters", i.e. any message format.

Claims 1, 15 and 21
Document D1 describes a method for estimating parameters of a multipath channel model, wherein the channel model is divided in different parts representing amplitude, delay, Doppler shift and different multipath components. The channel model parameters are transmitted to a transmitter unit, wherein the parameters are used to optimize downlink coding strategies (see for example D1 Chapters 1-2).

Consequently, the subject matter of claims 1, 15 and 21 is previously known and therefore lacks novelty.

Claim 23
Document D1 is considered to represent the closest prior art. D1 describes a method for estimating and transmitting channel model parameters of a sub-divided channel model from a receiver to a transmitter.

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Box V

The invention according to claim 23 differs from the method in D1 in that the transmitter requests a certain representation of the content of a channel measurement message.

Due to these features, the transmitter can decide when and how to receive a measurement report.

Consequently, with the background of D1, the problem is to design a device which can control a certain service, in this case the transmission of measurement reports.

However, for a person skilled in the art it is well known to ask for a service by sending a request indicating what service is to be received.

Therefore, it is considered obvious for a person skilled in the art to design an apparatus which transmits requests indicating the requested channel measurement parameters, as in claim 23

Thus, the subject-matter of claim 23 does not involve an inventive step

Claims 2-5

The subject matter of claims 2-5 describes: a channel filter function as a summing of sub-divided parts of the channel filter function, the sub-divided parts comprising information of significance, the channel filter function being represented as a channel impulse response and the channel filter function being reproduced as complex amplitude and phase parameters values.

From document D1, it is previously known to represent the channel model as a function being sub-divided in parts (see D1 equation 4), the channel filter function being composed of an impulse response (see D1 equation 2), and complex amplitude h_q, delay T_q and frequency f_q (see D1 equation 4 or 5).

Consequently, the subject matter of claims 2-5 is previously known and therefore lacks novelty.

Claims 6-14, 16-20, 22 and 24-25

The remaining claims are considered to involve particular detail executions obvious to a person skilled in the art.

CLAIMS

1. A method in a receiver unit (12) intended to receive communication signals from a transmitter unit (11) via a multipath channel (14), said method including

5 estimating parameters of a channel filter function of said channel from said received communication signals from the transmitter unit (11),

sub-dividing the channel filter function into two or more parts, a function of which representing an approximation of
10 the estimated full channel filter function,

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representing the complex parameters of at least a selection of said parts of the channel filter function as actual parameter values, or as incremental values indicating the
15 difference to a reference value,

composing a channel measurement message to be transmitted to the transmitter unit (11) of a portion including said parameter representations and a portion indicating the manner of representing said parameters.

20 2. The method according to claim 1, whereby said function performs a summing of the sub-divided parts of the channel filter function.

3. The method according to claim 1 or 2, whereby the sub-divided parts of the channel filter function comprise
25 channel information of a ranked degree of significance.

4. The method according to one of claims 1-3, whereby the channel filter function is represented as a channel impulse response in the time-domain.

AMENDED SHEET

5. The method according to claim 4, whereby the complex parameters of the channel impulse response are reproduced as amplitude and phase values.

6. The method according to claim 4, whereby the primary sub-divided filter function includes a representation of one or more of the most significant channel components.

7. The method according to claim 6, whereby the most significant channel component is the component having the shortest delay.

8. The method according to one of claims 1-3, whereby the channel filter function is represented as a channel frequency response in the frequency-domain.

9. The method according to claim 8, whereby a complex parameter of the channel frequency response is reproduced at least as an amplitude value and optionally by an additional phase value.

10. The method according to claim 1, whereby the complex parameters of said parts of the channel filter function are represented by their actual values in case of a significant change compared to a previous reference value.

11. The method according to claim 10, whereby the reference value corresponds to a previous channel parameter representation.

12. The method according to claim 10, whereby the reference value corresponds to a modelled estimate of the channel filter function.

13. The method according to claim 12, whereby the modelled estimate is a interpolation of the channel filter function from the complex parameters of the channel filter function.

AMENDED SHEET

14. The method according to claim 12, whereby said modelled estimate of the channel filter function has been received by the transmitter unit.

5   15. A message format for representing a channel filter function,

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a first portion (32) representing each of the complex parameters of the sub-divided parts of the channel filter function by at least an amplitude value and optionally by an additional phase value.

16. The message format according to claim 15, further comprising

a second portion (31) comprising an indication of the manner of representing said complex parameters including at least an indication α (312) denoting the influence of previously measured parameter values.

17. The message format according to claim 16, whereby α is a binary value.

18. The message format according to claim 16 or 17, whereby said second portion comprises an indication of the domain within which the channel filter function is represented.

19. The message format according to one of claims 16-18, whereby said second portion (31) includes an indication (313) of the sampling period for the complex parameter values of the sub-divided parts of the channel filter function.

20. The message format according to claim 15, whereby said representations of the complex parameters of the sub-divided parts of the channel filter function are associated to an indication (321) of a time or frequency instance.

(21) An apparatus intended for processing communication
signals received via a multipath channel, comprising

means for estimating parameters of a channel filter function
of said channel from said received communication signals
5   from the transmitter unit,

means for sub-dividing the channel filter function into two
or more parts, a function of which representing the
estimated full channel filter function,

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10   means for representing the complex parameters of at least a
selection of the sub-divided channel filter function as
actual parameter values, or as incremental values indicating
the difference to a reference value,

means for composing a channel measurement message to be
15   transmitted to the transmitter unit including said set of
parameter representations and a header field indicating the
manner of representing said parameters.

22. The apparatus according to claim 21, which is integrated
in a mobile user equipment.

20   (23.) An apparatus in a transmitter unit for transmitting
communication signals to a receiver unit,

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means for indicating a requested representation of the
content of a channel measurement message to be transmitted
25   to the transmitter unit in terms of the manner of said
representation.

24. The apparatus according to claim 23, further including
means for indicating at least an amplitude value and
optionally an additional phase value of the complex
30   parameters of a modelled estimate of sub-divided parts of a

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channel filter function as actual parameter values, or as incremental values indicating the difference to a reference value.

25. The apparatus according to claim 23 or 24, which is integrated in a radio base station.